The Occurrence of *Agrius convolvuli* L. in 1976 as Recorded from Peacehaven, Sussex

By Colin Pratt*

Further to a recent short note (*Ent. Rec.*, 1976, **88**: 232) reporting the capture of a male Convolvulus Hawk moth during July 1976, the following details have been extracted from my diary for that year. My purpose is to make the data available to other interested students of migratory trends and occurrences.

Observations

A purpose grown 7ft. plot of flowering *Nicotiana* plants (back-lit by a shielded 100 watt tungsten bulb for ease of observation) provided by far the main source of attraction to the moths—although as can be seen, the M.V. trap did take a few specimens.

A watch was kept for *A. convolvuli* for an hour each night after darkness fell, and on their arrival the swooping pre-feeding flight immediately became apparent in the comparatively yellowish light of the tungsten electric light bulb. After a few short passes they would settle down to feed, hovering gently, moving up and down the flower patch. Their wing-beats could be plainly heard as almost the whole length of the moth's proboscis was carried outstretched horizontally from flower to flower—probing each floral head for nectar. Few of the Convolvulus Hawks appeared to have a petal colour preference and several made as if to examine my person as I stood motionless before them, watching. Only in a single case did the electronic flash from my camera disturb a moth sufficiently for it to abandon the *Nicotiana*—although in contrast, they were all extremely sensitive to slight changes in light intensity, especially those caused or accompanied by movement.

Weather conditions naturally varied throughout the principal period of captures, but in the main flight-time temperatures of 10 to 12 degrees Centigrade, on still moonlit nights, were recorded. The odd cloudy and slightly gusty evening with improved temperatures occurred, but the most marked exception was September 10th when heavy cold rain and a gale failed to deter a female needing nectar. Thus it would seem that the normally favourable meteorological conditions for moths play a reduced role in the flight pattern of *A. convolvuli,* when compared to most other British species —although in my own experience, several species of Sphingidae fly in such weather, especially *S. ligustri* L. Nevertheless consistency was established, and the highest numerical results obtained on clear, cool, moonlit nights.

Despite releases, no previously noted specimens were seen subsequent to capture. An interesting phenomenon thus became apparent—during the 12-day period August 30th to September 10th inclusive, over a third of the insects noted were observed at exactly the same time each night and a

* "Oleander", 5 View Road, Peacehaven, Newhaven, Sussex.

figure approaching two-thirds appeared within the same 15 minute period. This trait was noted in Italy by Redfern (1962), as is their more general flight behaviour by Barrett (1895), Tutt (1901), Newman (1965), and many others. Altogether it was a memorable and inspiring visual experience with which mere descriptions, however graphic, cannot compete.

The details of the moths observed are as follows—those bearing an asterisk being taken at M.V. light.

Date	*B.S.T. — p.m.*	*Sex*	*Condition*
July 6th-7th	Unknown	M	Very poor*
August 26th	11.15	F	Good*
August 30th	8.30	M	Excellent
August 30th	8.40	M	Excellent
August 30th	9.05	F	Excellent
September 1st	8.15	M	Excellent
September 1st	9.15	M	Excellent
September 1st	11.30	F	Excellent*
September 2nd	8.15	M	Excellent
September 2nd	9.15	F	Excellent
September 3rd	8.15	F	Excellent
September 4th	8.25	M	Excellent
September 6th	8.20	M	Excellent
September 6th	8.45	M	Good
September 7th	9.05	M	Good
September 8th	8.15	M	Poor
September 9th	8.15	M	Good
September 9th	8.15	M	Poor
September 10th	8.30	F	Excellent
September 16th	7.55	M	Poor
September 18th	Before 11.00	M	Good*
September 19th-20th	After 10.00	M	Good*
September 20th	10.10	F	Excellent*
September 28th	Before 10.00	F	Excellent*
September 30th-October 1st	Unknown	M	Excellent*
October 3rd-4th	Unknown	M	Good*

The terms used to document the individual moth's physical condition are amplified as follows: — (a) Excellent—Perfect, a specimen without flaw. (b) Good—Wing with small but noticable scale of cilia deficiency. (c) Poor—Wings with excessive scale and cilia deficiency, including splits. (d) Very poor—Wing ends frayed with chips and splits, scales deficient to the point of transparency, etc.

To partially summarise the above list of observations, a total of 26 *A. convolvuli* were noted with a male/female ratio of approximately 2 to 1. The average male wingspan was 10.5 cm.—females 11.7 cm. Almost all the males examined were referable either to ab. *variegata* Tutt, or to ab. *virgata* Tutt.

The Question of Origin — Foreign or British

The unusual and consistently excellent conditions encountered, both of moths and weather, gave rise to several questions regarding their origin. There being few precedents for such an occurrence this century, the possibilities included a local

British brood having developed. Mr. Harman's recent interesting note (*Ent. Rec.*, **88**: 231) makes this rare event much more likely locally, with his discovery of larvae and a pupa in Kent during late August. Nevertheless, with only the sometimes misleading physical condition of the insects (Williams, 1965) on which to base such speculation, thought was given to a relatively unknown area in determining the phenomenon—the amount of fat present.

Fat Content

As Dr. Williams (1965) quoted, in his interesting book on the migratory habits of insects, that the quantity of fat present in a migratory insect appears to drop dramatically during a long flight, I decided to take this rather rare opportunity to carry out fat determinations on six *A. convolvuli*. The moths selected were the first capture in July as a "known" migrant for comparison, plus a further two males and three females from dates spanning all of September.

Although I anticipated possible substantial individual variations in fat content, I hoped that the result would at least be a check for the presence of a British brood. However, complicating the issue was the fact that a British bred moth flying locally could produce similar low fat yields to that envisaged from a foreign visitor—but only after prolonged activity. This was a secondary reason for recording, and reproducing in this paper, individual moth's physical condition on capture. The results of the chemical analysis were as follows and were calculated from the moths dry weight, excluding wings.

Date of Capture	*Sex*	*Fat %*
July 6th-7th	M	13
September 2nd	F	5.3
September 10th	F	6.3
September 19th-20th	M	31
September 20th	F	1.0
September 20th-October 1st	M	52

Whilst some of the fat contents were as anticipated, and that to be expected from a mixture of both foreign and locally bred moths, the females examined appeared to pose a problem. Although perhaps unlikely, and as far as is known without precedent, the results suggest a sexual differential in original average fat content, ex pupa. Nevertheless, the figures obtained are similar to parameters experienced by Dr. Williams when studying *P. gamma* L. in a similar manner. Apart from the aforementioned, there appears to be little published data on this rather specialised subject, but the figure of 52% found in a late male is not a surprising one—in a freshly emerged insect. It would seem that much of the fat is possibly a kind of "reserve supply" of available energy but more research is

necessary on this subject, especially on sexual comparisons ex pupa, and the relative utilisations of fat and nectar as fuels in lepidoptera, before firm conclusions can be drawn from this source alone. Further origin indicators were thus searched for, resulting in my attentions being directed to the closer examination of the females caught, and their eggs within.

On the Subject of Ova

As the total pre-emergence time spent alive often seems to affect sexual maturity (Newman, 1965), presumably mainly in the pupal stage, and as this must be relatively short if a home-grown brood is to have emerged, I hoped that examination of the mature ova ratio would provide further clues to the moths origins. There are, however, two complicating factors. As the species is also migratory to Europe and not indigenous (Newman, 1965) it seems likely that many records, especially those of a later date from Britain, are of offspring of migratory moths breeding on the continent. Therefore, if this is true the aforementioned tendency to sexual immaturity should also be present in these moths, but hopefully to a lesser extent. There is also the question of mature ova ratio present ex pupa. Several authors (Ross, 1965 and Williams, 1965) state that ova can develop in insects after emergence—from, and to, what extent in *A. convolvuli* under this year's conditions was a matter of conjecture. To minimise this effect, all dissected females were kept alive and fairly quiescent for a week before examination—allowing time for as much ova development as would normally occur.

Four females were kept in a quest for fertile ova, one being entrusted to my friend and colleague, Mr. G. Botwright of Newhaven. A variety of different techniques, temperatures and humidity changes were tried—all being completely unsuccessful. A single example was therefore dissected revealing a total of 315 slightly eliptical eggs—some of which were immature, their sizes varying widely when measured across the major axis. By comparison, the mature darker green ova measured on average 1,250 microns (1.25 mm.) with a relatively small size differential. Curiously, the mature egg size is somewhat at odds with several previous records of ova being noted or dissected out (Buckler, 1887 and Newman, 1965), these being larger than those previously noted. As the opportunity presented itself, two further female *A. convolvuli* were dissected—many of the resultant immature ova taking the form of half-filled egg capsules. The following details were also recorded: —

Date of Capture	*Number of Ova*	*% Mature Ova*	*Size of Immature Ova across major axis in microns*
September 2nd	315	80	500 to 900
September 10th	305	None	Mostly 300
September 20th	254	20	220 to 515

As can be seen, perhaps by coincidence, an almost complete series of ova maturity ratios were noted in only three moths—at least two of which had not deposited any eggs prior to capture (see the very large numbers of eggs encountered). Being a series, the result can only indicate that either no rule for ova ratios exists under the conditions examined, or, that both foreign and locally bred moths were in flight—but at different periods.

Although statistically a very small sample, only roughly a third of the ova examined were of sufficient maturity to be fertilised by (in this year of comparative plenty) an available male. At the stages examined in each moth's development, two-thirds of the eggs were immature—probably permanently. In the light of this information, perhaps the high rate of sexual immaturity should be suspected as a major cause of the relative paucity of larval records for *A. convolvuli* in this country, considering the number of adults noted. In addition, Newman (1965) quotes that the general experience amongst breeders of the species is one of an abnormally high mortality rate in the early stages of development after egg laying—due to ova infertility, and later, larval weakness.

The microscopic examination of *A. convolvuli* ova appeared to be a promising additional line of enquiry regarding origin differentiation—but again, obviously more research is necessary.

Comparisons

Two further potential sources of relevant information are available—the correlation of the conditions and dates of capture with other sightings throughout Britain, and similarly, accurate comparison of the sex ratios encountered. Both are unavailable to me at this time.

Time and Theory

After checking many sources, it would seem that a minimum period of approximately three months is required for *A. convolvuli* to complete a life cycle in Britain, without forcing. There are many records which exceed this figure, all individual stages being subject to wide fluctuations in time scale. However, bearing in mind the heat of the 1976 summer, it seems not an unreasonable period on which to base any time cycle calculations. This time element thus virtually eliminates the possibility of a British emergence before late September—unless an extremely unusual, very early, and unrecorded migration occurred. Notwithstanding the time element, an early local brood should yield different fat and ova results than those found. However, a migration during late August/early September would explain the comparatively low fat contents, high mature ova ratio, and the decline in physical condition from September 6th onwards. Should a local brood have developed from a late June/early July migration, one would expect a re-occurrence of the species in late September —but again with specific and different characteristics. The British bred specimens may be physically smaller but in very

good condition, with high fat contents and a low ova maturity ratio in the female. Many of these criteria were achieved in all the insects examined from the latter section of the noted observations. Consistency to the theory of a local late September emergence is strengthened when plotting time against occurrence using a histogram.

I understand there has been a further, somewhat complicating, series of *A. convolvuli* observations from very late September through mid-October—at least one female of which laid fertile ova. Without analysis of the individuals involved, one can only postulate the theory that they were migratory in origin, possibly having the same parents as the main earlier influx—yet spending sufficient time in the pupal stage to yield sexually fertile adults.

Tentative Conclusions

Balancing all the information available to me at this time, it would therefore seem that a relatively small migration took place in late June/early July, possibly trans-continentally—fertile ova being successfully deposited, at least locally, in Sussex and Kent. In late August and the first third of September a massive migration of the species occurred, probably emerging in Europe—many, but by no means all, being infertile moths. The second third of September saw the gradual phasing out (and/or moving on) of the migration, with possibly the first odd local emergence. The final section of the month, including the October record, saw a numerically small resurgence of occurrences due to the local emergence proper. Regarding the final apparent migration noted in the South at this time, it is concluded that it was not recorded from the Peacehaven locality.

As was stated at the beginning, my intention has been to provide information, but also to stimulate the reporting of sightings and possibly different interpretations of the available data concerning the 1976 occurrences of *A. convolvuli,* if considered appropriate.

Perhaps the most important point to arise from this paper, is the necessity for an assemblage of all available information on the species as noted during 1976. Otherwise, it will be a rather difficult task to cement the firm and important conclusions available, surveyed as they are at the moment, from a single geographical (and personal) standpoint.

As a final conclusion, to quote a friend, a lepidopterist of some 60 years standing: "The more one learns about moths, the less one really knows".

References

Barrett, C. G., 1895. *The Lepidoptera of the British Isles,* **2**: 25-26.
Buckler, W., 1887. *Larvae of British Butterflies and Moths,* **2**: 108.
Newman, L. H., 1965. *Hawkmoths of Great Britain and Europe,* 59-62.
Redfern, J. H., 1962. Other Occurrences of *A. convolvuli* in 1962, *Ent. Rec.,* **74**: 275.
Ross, H. H., 1965. *A Textbook of Entomology,* 180.
Tutt, J. W., 1901. *Practical Hints for the Field Lepidopterist,* **1**: 76, 87.
Williams, C. B., 1965. *Insect Migration,* 99, 183, 185-186.